Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/713
FINLAND
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

On Nonlinear Reactor Kinetics

Eino Tunkelo
Institute of Technical Physics
Institute of Technology, Helsinki

The nonlinear features of reactor kinetics including the effect of the prompt negative temperature coefficient of reactivity are studied both experimentally and theoretically. Two extreme cases are considered: transients produced by an instantaneous addition of reactivity and the steady state response of the reactor to sinusoidal variation of reactivity. The experiments have been performed with a TRIGA Mark II reactor.

The unsymmetry of the produced pulse and its succeeding "tail" are studied in the transient experiments. The experimental determination of the pulse is carried out by three different methods: 1) by using a boron coated ionization chamber in connection with a recording oscillograph, 2) by recording the intensity of the Čerenkov radiation in the core with a photomultiplier fitted to an appropriate optical system, and 3) by using a multichannel time analyzer to record the intensity of neutron capture gamma rays from the 8.2 eV resonance of samarium. The subsequently developed theory shows that the measured properties can be described satisfactorily by the properties of the delayed neutron groups and the transfer of heat from the fuel to the water moderator.

The response of the reactor to a sinusoidal variation of reactivity is studied in terms of the fundamental and some lower order harmonic as well as subharmonic components. The analysis of the response is performed on the basis of physical concepts as well. The nonlinear transfer functions of the reactor for reactivity variations of larger amplitudes are derived and their relationship to the transient properties are discussed. Finally, the stability of the reactor under normal operating conditions is studied and is found to be satisfactory.